



**Establishment and Operation of a Regional System of Fisheries Refugia in
the South China Sea and Gulf of Thailand**

POLICY BRIEF

**FISHERIES REFUGIA OF PENAEID SHRIMP
IN WEST KALIMANTAN**

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Policy Brief

FISHERIES REFUGIA OF PENAEID SHRIMP IN WEST KALIMANTAN

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Executive Summary

West Kalimantan waters, as one of the Penaeid Shrimps landing centers in Indonesian Fisheries Management Area (IFMA) 711, are facing shrimp fisheries production decline due to the high exploitation rate in this area. Economical shrimps known for their abundance in this area were banana shrimp (*Penaeus merguensis*) and white shrimp (*Penaeus indicus*). The shrimp production from the West Kalimantan Province recorded from 2016-2021 showed a declining trend. This phenomenon was caused by both high fishing pressure and the indication of environmental factors change which might be leading to the reduction of habitat quality essential for the shrimp's life cycle.

Fisheries refugia was one of the fisheries management strategies based on several approaches involving area zonation, habitat rehabilitation, and reduction of fishing pressure during the critical life cycle. This strategy was aimed to enhance the sustainability of fisheries resources. The fisheries refugia concept could be applied to increase the survival rate of the shrimp during the critical stage, i.e., the shrimp-larval stage by protecting the spawning area and the shrimp-juvenile stage by protecting the nursery area.

The designation of shrimp fisheries refugia area in West Kalimantan water was conducted through several considerations, i.e., shrimp biological aspects, habitat suitability, social-economy aspects, and the established fisheries management. The shrimp fisheries refugia area in West Kalimantan Province was recommended to cover 4.094,32 Km² (409.432 Ha) by including several coastal areas on site such as Padang Tikar (Kubu Raya District), Dusun Besar, and Teluk Batang (Kayong Utara District), as well as Delta Pawan (Ketapang District).

Introduction

Penaeid shrimp was an export-class leading fisheries commodity in Indonesia. West Kalimantan water as part of IFMA 711 known as potential penaeid shrimp habitat, especially for *Penaeus merguensis* and *P. indicus*. According to the Marine and Fisheries Department for West Kalimantan Province, there was a declining trend in shrimps production over the last six years (2016-2021).

As one of the fisheries resource rehabilitation approach, the fisheries refugia concept offers a solution to overcome the shrimp stock decline by developing synergy between the local fishermen and the government. This synergy was expected to increase shrimp resource sustainability.



Fisheries Refugia Definition

In the Fisheries Refugia concept, strategic management to protect species with high-economical values during the critical periods of their life cycle phase. This management was implemented by identifying and assigning marine or coastal areas to be protected for their role as habitats for shrimp in their critical phase. In Fisheries Refugia, it was known management integration between fisheries commodity and their habitat that cover certain areas and be focussed on the balance between fish life cycle and fish stock sustainability (UNEP, 2007).

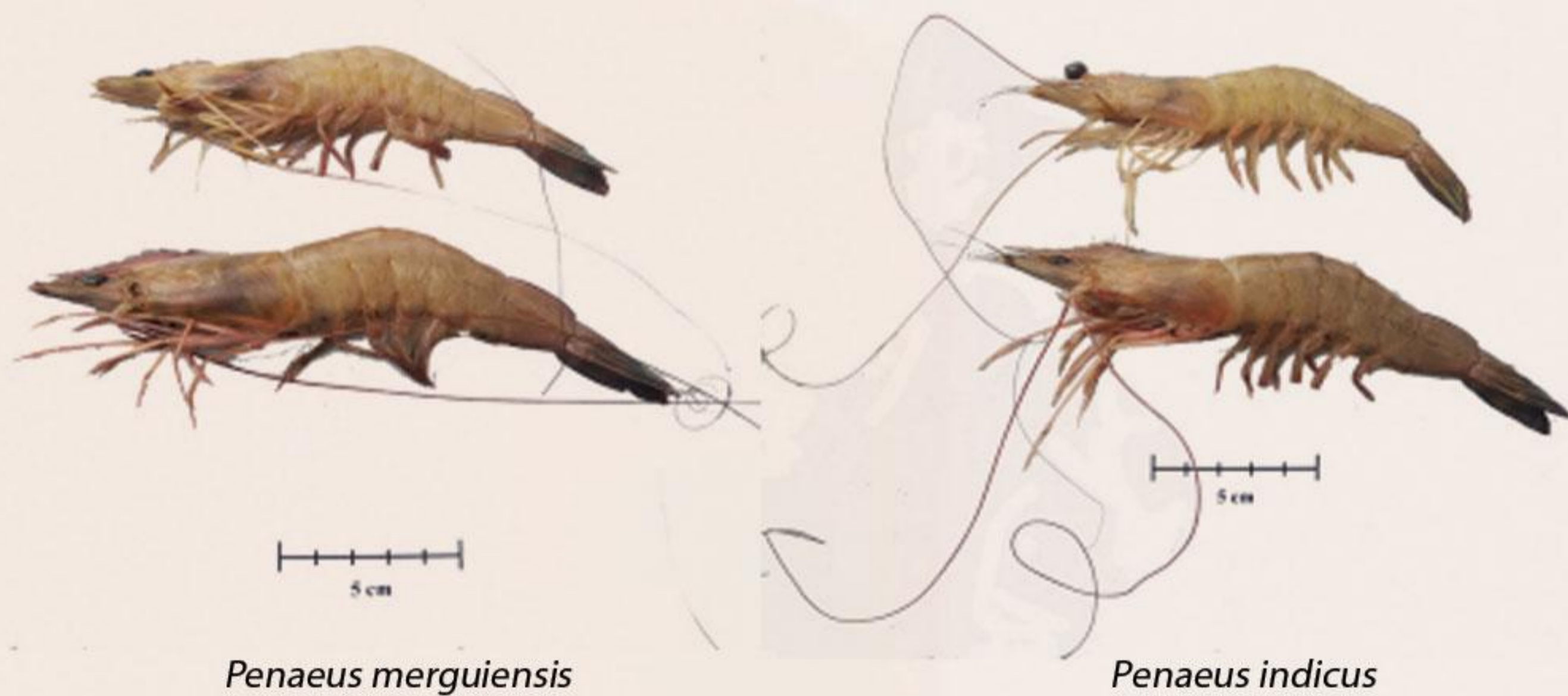


Figure 1. Economics-valued shrimps from West Kalimantan Province

Economics-Value Shrimps

High-economical valued shrimps from the coast of West Kalimantan were identified as banana shrimp (*Penaeus merguensis*) and white shrimp (*P. indicus*) (Figure 1). Both shrimps were classified as penaeid shrimps (*Penaeidae*).

Based on the study conducted in 2021 (BRPSDI, 2021), evidence of matured shrimp in this location has been acquired (Figure 2). Prior to the Fisheries Refugia concept implementation, identification regarding the shrimp life cycle in investigated location is essential. In general, the penaeid shrimp life cycle could be classified into two phases, the oceanic phase and the estuarine phase. The adult female shrimp will move to the deeper water to spawn. The fertilized eggs were hatched to enter the oceanic larval phase and then grow into the estuarine juvenile phase (Figure 3).

Shrimp Fishing Gears

Shrimp fishing gears widely used in West Kalimantan can be classified into two types, active and passive gears. Active fishing gears operation were pulled by a small vessel (<5 GT), e.g. bottom trawl and trammel net. Those gears were considered the most effective gears in shrimp fishing, especially the adult shrimp from 10-30 m depth. The operation of active fishing gear was from March to July and from September to January.

Passive fishing gear like tidal trap nets was constructed on the tidal zone (<10 m depth). The shrimp catch using this gear was mostly obtained on high tide and low tide. This mechanism didn't involve the use of vessels. The small ship was used only for transportation of the shrimp from the constructed gears to the mainland. The use of unmanaged passive fishing gears may lead to over-fishing, especially during shrimp recruitment (recruitment over-fishing).

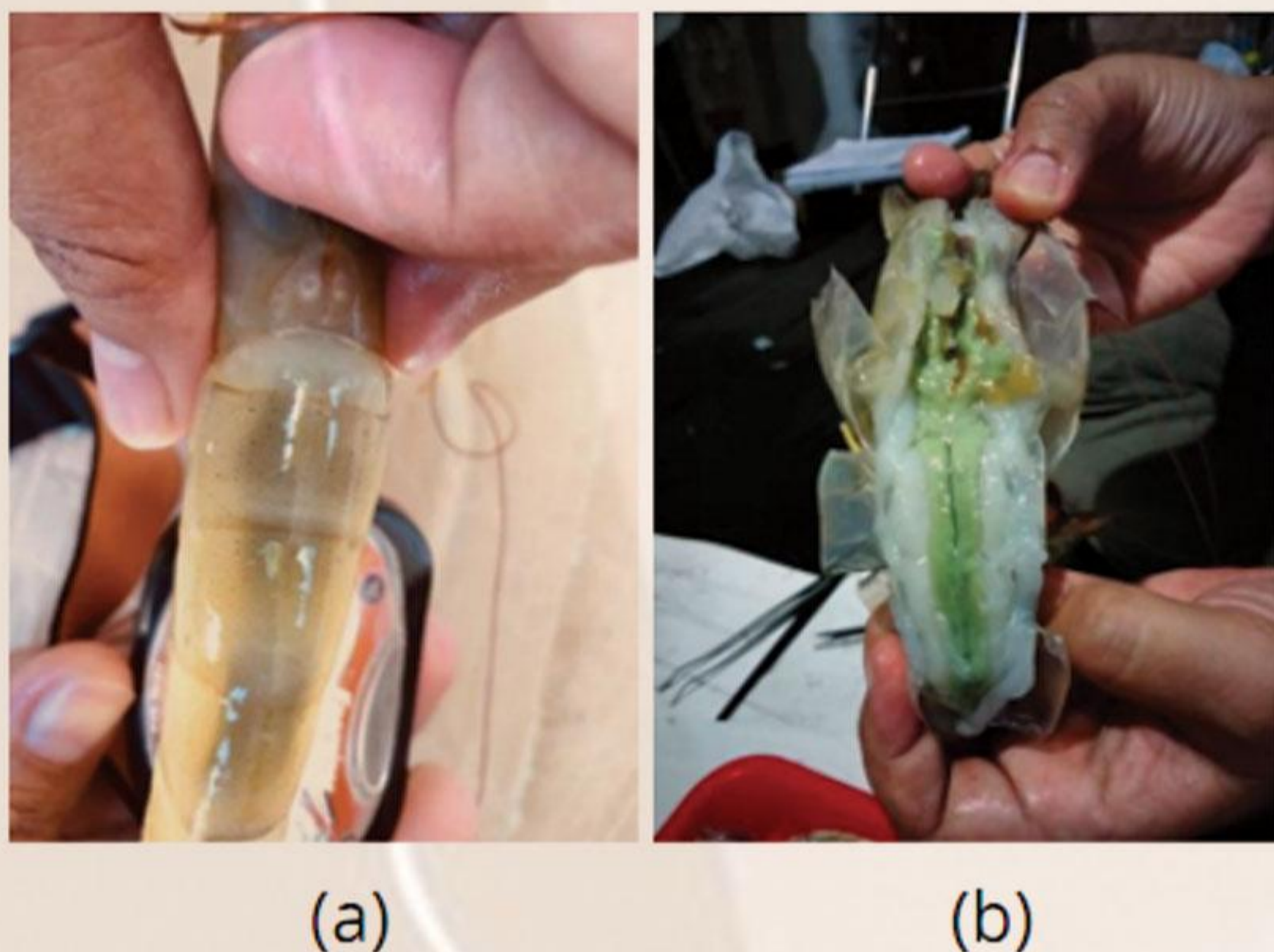


Figure 2. Gondal condition of mature banana shrimp
(a) pre-dissection appearance
(b) post-dissection appearance

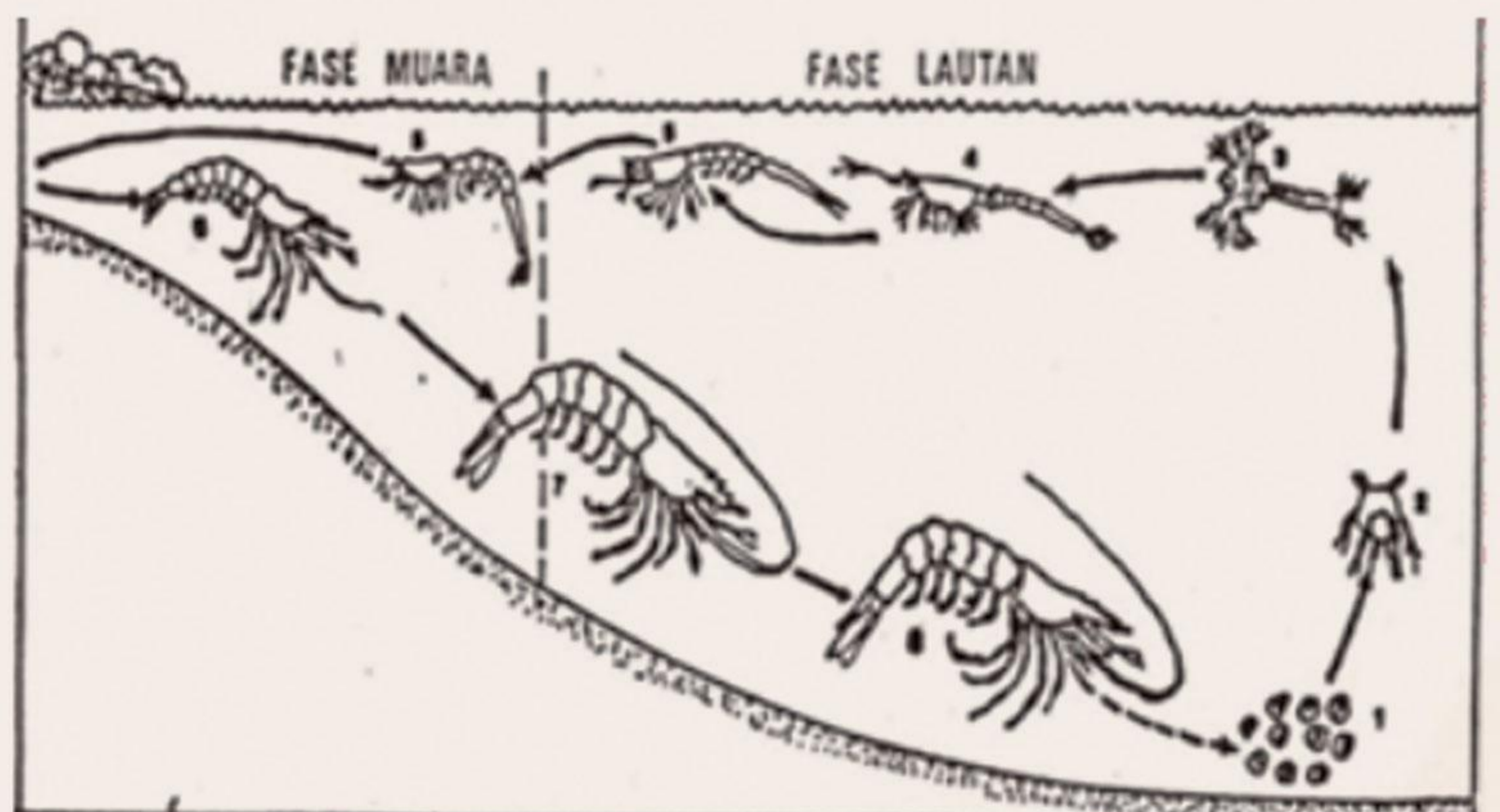


Figure 3. Penaeid shrimp life cycle (Wyban & Sweeney, 1991)

ESSENTIAL HABITAT CONDITION

Nursery Area

Nursery areas for the penaeid shrimp population existed on estuarine waters and adjacent mangrove stands. 92% of shrimp caught in this area were in the larval and juvenile phases. Investigation regarding water and mangrove ecosystem quality resulted that this area being suitable for the nursery area. Thus, this area was recommended to be a fisheries refugia area for the protection of shrimp larvae and juveniles.

The penaeid shrimp nursery habitat characteristic in West Kalimantan was belonging typical 4-40% mangrove coverage. The existence of the true mangroves ranged from 15-39 species. The abiotic parameters examined on location ranged from 27-34.1 ppt for average water salinity, 27.7 – 32.6 for surface seawater temperature, 7.32 – 8.32 for pH, and 0.7 – 28.7 NTU for water turbidity level. The shrimp larvae and the juvenile were found in high abundance in several locations, i.e., Padang Tikar (Kubu Raya District), Teluk Batang (Kayong Utara District), and Delta Pawan (Ketapang District), on 5-10 m water depth and 4 miles to the sea.

The expansion of the mangrove forest area on the Kayong Utara coast has increased from 41.500 Ha in 2015 to 45.087 Ha in 2019. This ecosystem rehabilitation supported the suitability of this area s nursery habitat for penaeid shrimp. Nevertheless, numerous anthropogenic activities existed was still can be considered a threat to the shrimp juveniles' survival rate. This might cause by the use of non-selective fishing gears, mangrove deforestation, and water transportation.

Spawning Area

The spawning area plays important role in the shrimp life cycle for the protection of matured female shrimp. An individual female banana shrimp could produce 125.000 – 972.000 eggs in a single spawning event (Naamin, 1984). In the Kubu Raya and Kayong Utara coastal water, between 20-30 m in depth, was expected as the existing spawning ground for penaeid shrimp. The evidence was supported by 60% of banana shrimp and 22% of white shrimp caught in these areas were in riped gonadal condition. The spawning season was identified between November to December. The higher survival rate of the shrimp in the early-life phase would increase the success rate of shrimp recruitment.

Fisheries Refugia-based Management Model

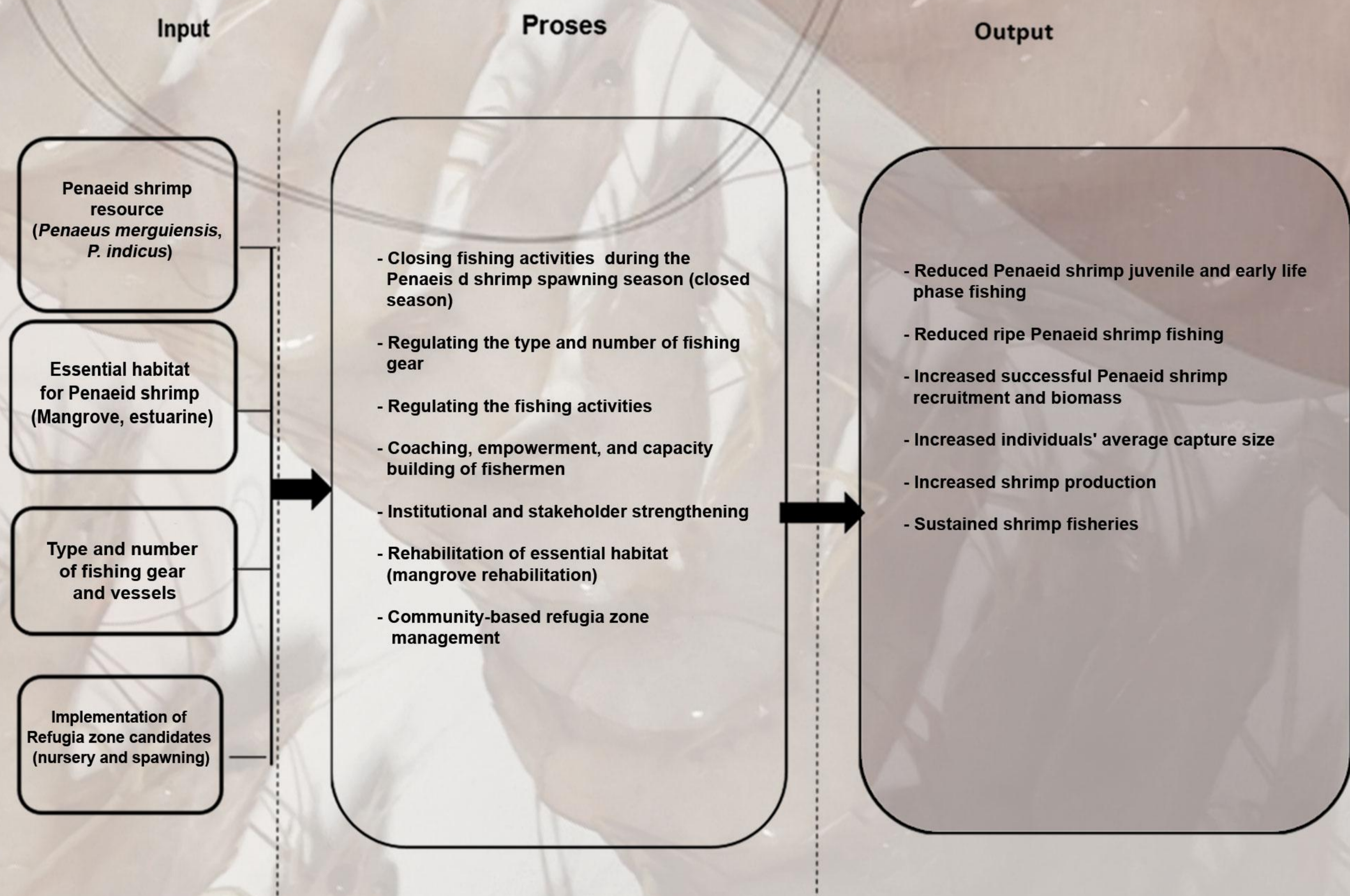
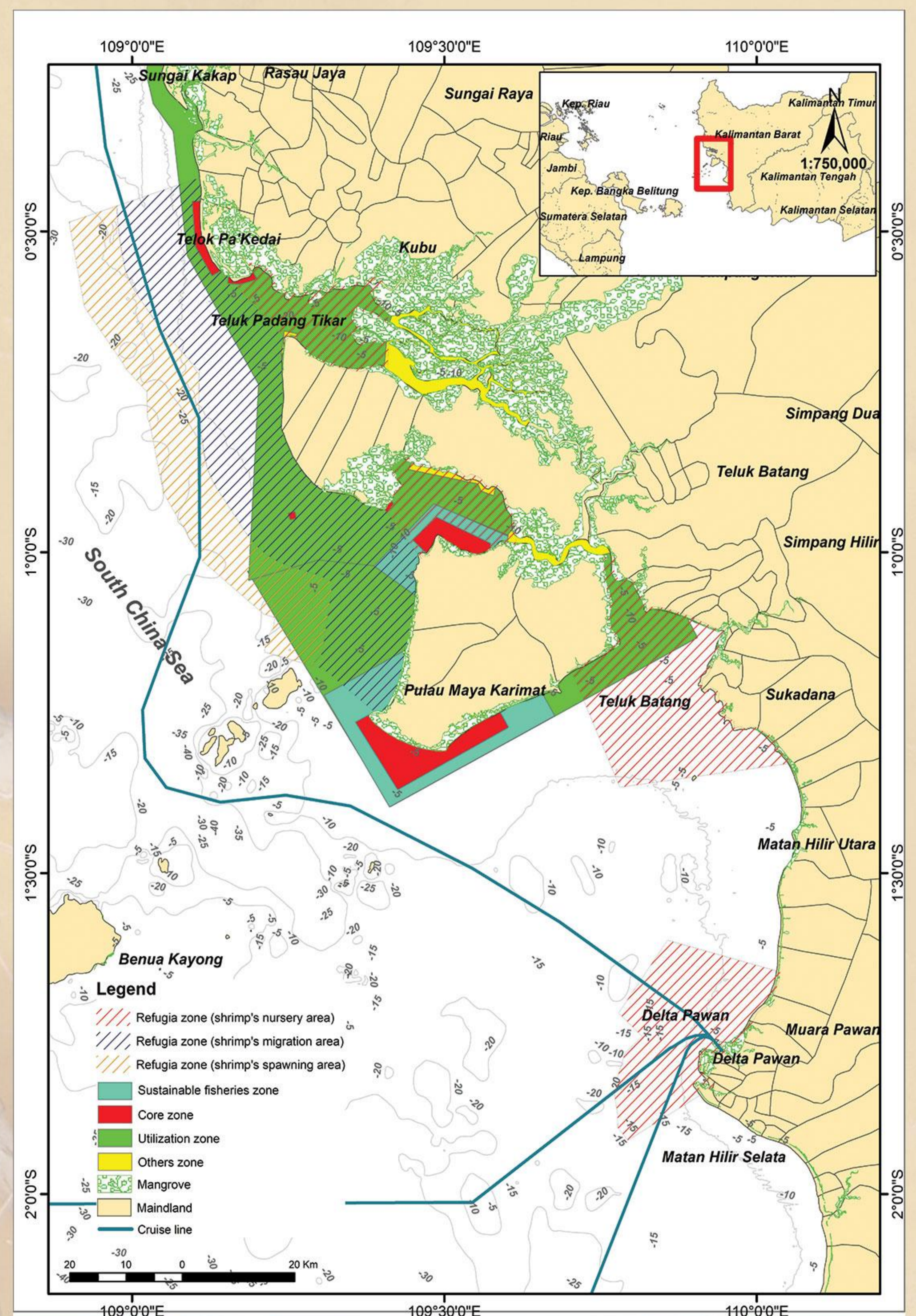


Figure 4. Flowchart showed fisheries refugia-based management model recommended for penaeid shrimp management in West Kalimantan.

The fisheries refugia concept development based on area zonation was considering several aspects, i.e., shrimp resource, habitat, social economy, and management. The management was necessary to note the connection between input, process, and output elaborated in Figure 4.

RECOMMENDATION

- Propose 4.094,32 km² (409.432 Ha) as penaeid shrimp fisheries refugia area around Kubu Raya District, Kayong Utara District, and Ketapang District (Figure 5).
- Propose shrimp fishing control through,
 - Reduction of 20% of existing operational shrimp fishing gears (bottom trawl and trammel net)
 - Rearrangement passive shrimp fishing gears
 - Implementation of the closed fishing season in November and December.
- Propose shrimp habitat management through rehabilitation of mangrove forests, increasement of public awareness regarding eco-friendly fishing gears, protection of shrimp habitat, and rearrangement of the water transportation route in fisheries refugia area.
- Propose the improvements of social, economic, and management aspects through,
 - Improvements of system and quality for penaeid shrimps fisheries data collection
 - Intensification of socialization and supervision post to regulation implementation
 - The active role of community business group improvements
 - Establishment of community monitoring groups
 - Strengthening local wisdom that essential to preserve
 - Arrangement of the vessels fuel distribution process to be organized and scheduled
- Regulating marine spatial utilization permits include:
 - re-arrangement of permits for fishermen with passive fishing gears (including the local community), based on Government Regulation No 21/2021 regarding the Implementation of marine spatial planning.
 - Propose marine spatial planning activities approval in accordance with the Minister of Marine Affairs and Fisheries Decree Number 28/2021
- Propose monitoring activity for assigned fisheries refugia areas which may be conducted every 3 (three) years accompanied by an evaluation every 6 (six) years since the settlement of the regulation.



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